ERIC Document Resume	See Instruction Sheet	DATE OF RESUME	DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER	2. ORIGINATOR CONTROL NO(S).	3. IDENTIFICATION NO.
ED002278	N.A.	CR 1203

DO NOT WRITE IN SPACE BELOW

4. AUTHOR(S): Entwisle, Doris R.

5. TITLE OF DOCUMENT ABSTRACTED: Set-Learning in Gifted High-School Students

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN: The Johns Hopkins ORG. University, Baltimore, ST. Maryland CITY, STATE

9. PUBLISHER OR SOURCE: Cooperative Research Program, Office of Education, Dept. of Health, Education, & Welfare, Wash., D.C.

TELE. EXT. INST/LOC CODE

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
N.A.	N.A.	1961	21

MICROFILM COPY AVAILABLE: YES ☒ NO ☐

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TYPE OF REPORT: PROPOSAL ☐ IN-PROGRESS ☐ FINAL ☒ FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR: Report

16. INDEXING TERMS (6-12)

gifted students	teaching techniques	superior students		
teaching aids	learning theories	psychological set		
education research	set-learning			
	learning methods			

17. ABSTRACT (MAX. 250 WORDS)

Two replications of an experiment were carried out with gifted (mean verbal IQ -- 127) 11th grade students in a large high school. The main purpose was to explore whether "set-learning" might be a mechanism of learning employed to a marked degree by gifted secondary students. Control and experimental groups were the two top-ability classes in two successive 11th grades. Sex representation and IQ levels were matched.

A test on the States-of-origin of U.S. senators was the criterion of learning. The pretest listed 5 States following each senator's name. All subjects were given the 96-item test initially (pretest). Following pretesting, the experimental group was trained on pairs of senators from only 12 States. Two training sessions were given to the experimental group. A posttest was then administered which was identical with the pretest except that the party affiliations of the senators were added. It was hypothesized that students in the experimental group would learn more material similar to the type used in training, girls would manifest set-learning to a greater degree than boys, and subjects in the control group would tend to learn the material used to train their classmates. The data indicated that girls did tend to learn materials for which they were untrained to a statistically significant degree, although the amount of learning was small by practical standards. Set-learning was not induced in boys by the present experiment. It did not seem likely from this experiment that set-learning, viewed as a special learning mechanism especially typical of gifted students, has great practical importance. Further exploration of the significance of sex differential was indicated.

ERIC No.

18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION	20. DIVISION OR DEPT.	21. CONTRACT NO. / PROJECT NO.
	22. TOTAL COST OF PROJECT	
	23. DURATION OR PROJECT	U.S. Department of Health, Education, and Welfare Office of Education

ERIC Form 1

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1203

Set-Learning in Gifted High-school Students

Cooperative Research Project No. 1203

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Department of Education

The Johns Hopkins University

Baltimore, Maryland

1961

The research reported herein was performed pursuant to a contract with the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education and Welfare.

Acknowledgments

Most of this research was carried out while the author was a post-doctoral fellow of the Social Science Research Council in the Department of Education, The Johns Hopkins University.

Professor J. M. Stephens of The Johns Hopkins University gave much helpful advice in connection with this experiment, and the Department of Education of The Johns Hopkins University provided some of the facilities necessary to conduct the experiment. Grateful acknowledgment is made to the Baltimore County Board of Education, and to Mr. Roland English and Miss Margaret Webster of the Catonsville Senior High School, for their cooperation.

Abstract

Two replications of an experiment were carried out with gifted (mean verbal IQ = 127) 11-th grade students enrolled in a large suburban comprehensive high school (N = 30 girls, N = 22 boys). The main purpose was to explore whether "set-learning" might be a mechanism of learning employed by gifted secondary students to any marked degree.

Two classes (the top-ability class in two successive 11th grades) were divided randomly into control and experimental groups so that sex representation and IQ levels were the same.

Control and experimental groups were formed within classes, so that sex representation was equal and IQ levels were the same. Data for two successive and very comparable classes at the same school were combined.

A test on states-of-origin of U. S. senators was the criterion of learning. The pretest listed 5 states following each senator's name, and Ss were required to circle the name of the state from which the senator came. All Ss were given the 96-item test initially (pretest). Following pretesting, the experimental group was trained on pairs of senators from only 12 states (24 senators). Work prior to the experiment had established that the average difficulty for these 24 items was the same as the average difficulty of the 72 items withheld from training. Training on pairs of senators eliminates the possibility of positive transfer between the segment of material (24 items) used for training, and the segment (72 items) withheld. Following two training sessions conducted with the experimental group only, all Ss were again tested. The posttest was identical with the pretest except that party-affiliations of senators were added, and Ss were required to check party-affiliations of senators as well as states-of-origin.

It was hypothesized in advance that:

(1) students in the experimental group would "learn" more material similar to the type used in training (the 72 withheld items) than the control group

(neither group was trained directly on the material) because training (on 24 items only) would establish a set to learn this type of material when it was encountered vicariously outside the experiment;

(2) girls would manifest "set-learning" to a greater degree than boys;

(3) Ss in the control group would tend to learn the material (24 items) used to train their classmates in the experimental group (presumably via direct communication);

(4) the set established by training would generalize from one "dimension" of the subject-matter to another--a set to learn states-of-origin might result in increased learning of party-affiliations of senators.

The main purpose of the experiment was to determine whether set-learning might be an "important" learning mechanism employed by gifted students.

With respect to (1) and (2), the data indicate that girls tended to learn untrained material (the 72 withheld items) to a statistically significant degree, although the amount of learning is small by practical standards (about 2 items). Set-learning was not induced in boys by the present experiment.

Results for hypotheses (3) and (4) were essentially negative: students in the control group did not appear to learn material (24 items) used to train their classmates. Effectively this experiment did not test generalization of the set because the party-affiliation test had reliability so low (.44) that it could not serve as a learning criterion.

It does not seem likely from this experiment that set-learning, viewed as a special learning mechanism especially typical of gifted students, has great practical importance. Gifted girls in the experiment did manifest set-learning, but the effect noted was small by practical standards although statistically significant. The sex difference, however, is consistent with sex differences in learning noted by others working with gifted students and also with sex differences in "placebo" effects of experiments. It is suggested that sex differences in learning, particularly for gifted students, deserve further study.

Although each year sees the appearance of many articles and books relating to the "gifted", little has yet been done to elucidate special learning methods that may differentiate these students from their less gifted classmates. Or perhaps learning methods employed by the gifted differ only in degree and not in kind from those used by average students, but in any case, further study is needed if special classes and schools for gifted students are to operate with optimal results. Interactions between learning and individual differences in talent have been relatively neglected both in learning theories and empirical research, as Melton (1959) points out. Interactions between learning and other subject characteristics (i.e., sex) have also been neglected.

A previous experiment (Entwisle, 1960) indicated that perhaps gifted students more readily develop a set to learn a specific type of subject-matter than average students. Compared to students at the low end of the intelligence distribution, fourth-grade pupils in the top fifth of the IQ distribution tended to learn more material vicariously than would be predicted on the basis of the IQ differences alone. The interaction between ability level and amount of vicarious learning was significant at about the 2% level. This was an a posteriori finding, however, and so was viewed as a suggestion to be pursued in further research. Nevertheless, even though an hypothesis relating set-induction to ability level had not been formulated prior to the fourth-grade experiment, other evidence suggests that "set learning" may characterize gifted students. For instance, Koch & Meyers (1959) report that in nursery school children ease of inducing a learning-set is correlated with intelligence, and earlier Hull(1933) noted a similar correlation in older children.

The present experiment attempts to establish whether gifted high school students employ "set-learning" to a measurable extent, and whether sex is a significant factor in development of learning sets in students of this age group. The experiment also has implications for experimental methodology and

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generalization of sets that can best be pointed up when the experimental procedure is explained.

Method

This report covers two replications of an identical experiment with two 11th-grade "gifted" classes, the "top-ability" class in two successive years for the same large (1500 students) suburban comprehensive high school.[1] Ability level is determined from verbal IQ only. Average IQ was 127, with range from 115 to 145.

Within classes, Ss were first divided by sex, and then ranked on IQ. Successive IQ-pairs, within sexes, had members assigned randomly to either a control or an experimental group. Thus each class was randomly divided between an experimental and a control group, with sexes equally represented and IQ levels the same.

Initially all students were given a pretest on states-of-origin of U. S. senators. This test listed 96 U. S. senators, and following each senator's name, five state-names appeared. The position of the correct state and the use of names of other states as distractors was random (see Appendix A). The control group then received no further treatment until the final test.

The experimental group was given two training sessions, one per week for two weeks, on 24 senators only (two senators from each of 12 states) using a

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[1] In the first year of the experiment, two classes were used: a "second-level" ability class was included as well as the "top-ability" class. Subsequent analysis indicated that the criterion test was too difficult for the second-level group, with the consequence that the test had reliability below .70. For the two top-ability classes included in this report, the test had reliability very close to 0.90 and prior to the experiment a trial of the test with 58 college students yielded a reliability of 0.89. Therefore full analyses were carried out only for the top-ability classes, and further discussion of the second-ability class is omitted from this report. All reliabilities were calculated from pretest scores using Kuder-Richardson formula 20.

paired-associates method. Slides with a senator's name were presented for 0.1 sec. using a tachistoscopic projector; time was then allowed for students to write on an answer sheet the state-of-origin of the senator; then the name of the correct state was exposed for 0.1 sec. The list was covered twice (in scrambled order) during each training session, so in all four times.

One week after conclusion of training of the experimental group, all students were again tested. At posttest the students were required to check party-affiliations (Republican vs Democrat) of senators as well as states-of-origin. (See Appendix A.)

Test Segments. Prior to the experiment, the test was tried out on 58 persons, as mentioned earlier. This permitted the test to be divided into a segment with 24 senators (one-quarter of the test) and a segment of 72 senators in such a way that the average difficulty on both segments was approximately equal. This prior division was carried out so that the 24-item segment could be used for direct training of the experimental group during the two training sessions, and presumably establish a set to learn states of origin of U. S. senators. The remaining 72 senators upon which no one was trained, provide a vehicle for measuring to what degree students tend to learn similar material outside the experiment. That is, it was hypothesized that training upon only a portion of the total material would generate a set to learn this general type of material, and that trained students (experimental group) would learn more of this material upon vicarious exposure than untrained students (control group). The question at issue is whether gifted students employ set-learning (will learn unexposed material) to a measurable extent.[2]

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[2]Ideally, one would like to contrast the use of set-learning by gifted students with its use by non-gifted students, but at the secondary level this comparison is impossible. Many other characteristics besides ability-level differ between the gifted and the non-gifted: their curricula, usually their ages, their socioeconomic status, etc., so that an unconfounded comparison cannot be made.

It should be noted that the 24-item and 72-item segments were constructed so that no answer (state) overlapped the 2 segments. This should prevent positive transfer from one segment to the other (for more discussion of this point see Entwisle, 1961a, p. 96).

The posttest provides 2 scores for each person:

	State-of-origin	
	trained	untrained
Experimental group	mean 1	mean 2
Control group	mean 3	mean 4

By comparing the performance of the experimental group on untrained material with that of the control group on untrained material, one can measure the extent to which inducing a set to learn this material (engendered by the training sessions) led to increased extra-experimental learning, and also, by comparing the scores on trained and untrained material for the control group only, one can measure the effect of communication within the experiment. Often difficulties in measurement are posed in experiments like the present one because students in an experimental group communicate information given them in training sessions to their classmates who supposedly are receiving "no training sessions to their classmates who supposedly are receiving "no training" -- thus, at the conclusion of an experiment when the performance of the experimental group is measured from a baseline established by the control group, the difference may be adjudged insignificant because the performance of the control group has been raised above its "basal" level. This comparison of the two scores of the control group bear on a different hypothesis than the main hypothesis of the present experiment, and is directed toward a methodological problem. When an experiment is carried out in a school, students may communicate with one another, and probably interest stirred up by an experiment stimulates such communication. The "effectiveness of training" may therefore be underestimated, because communication will cause the control group to gain more on the experimental material than would be the case if they were unaware that an experiment was in progress. By withholding some of the experimental

material entirely

from both groups, "spurious" gain of the control group on the experimental material can be assessed, for without communication the control group should gain the same amount (within sampling fluctuations) on both the material shown to the experimental group and equated material of the same type that is shown to no one. It was found earlier (Entwisle, 1961a) that students in a control group apparently did "learn" material used to train their classmates, even though they received no direct training themselves during the experiment.

In addition to scores based on states-of-origin, scores on party-affiliation of senators were obtained from the post-test only. It was desired to ascertain whether a set-to-learn generalized from one "dimension" of the subject-matter (states-of-origin) to another "dimension" (party-affiliations), since in laboratory experiments such generalization has been found (see, e.g., Postman & Senders, 1946). It turned out (see below) that the test on party-affiliations was too unreliable to be of use.

Results

States-of-origin analysis[3]

Communication effect. There was no increase in control-group scores on the segment of the test (24 items) used to train the experimental group. Control Ss, both boys and girls, scored less on posttest for trained material (24 items) than they had on pretest (decrease 0.5 items for girls, and 0.8 items for boys). Apparently the Ss in the control group were unaffected by the experiment that was being conducted with their classmates.

This result is at odds with previous observations. Aside from the fact that "communication gains" may be rare in an educational experiment, there are three factors which might militate against a communication gain manifesting itself in the present experiment: 1) These Ss are older and "more sophisticated" than the 4th-grade Ss of the previous experiment. They have taken many kinds of tests and perhaps fail to be impressed by being involved in an experiment.

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[3] Raw data are given in Appendix B.

2) In a large secondary school, conditions may not favor communication. Whereas 4th-grade Ss remain with their classmates throughout the day and live in a neighborhood contiguous with the school, secondary-school Ss have different classmates from hour to hour during the school day and reside over a very large geographical area.

3) This experiment involved 52 Ss, whereas the former experiment involved 180 Ss. Fewer Ss increases the likelihood of making a Type II error.

Gain on unexposed material. The principal purpose of this experiment was to test whether training of gifted secondary students on only a part of some material would result in extra-experimental learning of another independent part of the same body of material. In particular, the experiment was carried out to see if large enough gains on unexposed material would occur that one might infer that gifted students learn appreciable amounts of material through "set-learning" mechanisms. A secondary hypothesis was that amounts learned extra-experimentally would be larger for girls than for boys, since girls are presumably more suggestible.

Results were combined for the 2 replications (classes one year apart) so that there are parallel analyses for boys and for girls. Scores on pretest are analyzed vs. scores on posttest, where each score is the sum of the correct items on the segment of material withheld from training. (No one was trained on this material, but the experimental group was trained on similar but independent material.)

Table 1 summarizes results of an analysis of variance of girls' scores. Principal interest attaches to the PP x E-C interaction, significant beyond the .001 level. Girls in the experimental group gained significantly on unexposed material from pre- to post-test, whereas girls in the control group did not. In Table 2 a similar analysis of variance for boys shows no difference between gains

Table 1

Analysis of Variance - Scores of Girls on Unexposed Material
(N = 30)

Source of variation	d.f.	Mean Square	F
Between Subjects	29		
Experimental vs. control (EC)	1	17	
Error between	28	73	
Within Subjects			
Pretest vs. Posttest (PP)	1	6	
PP x EC	1	49	11.53**
Error within	28	4.25	

**Significant beyond .001 level.

Table 2

Analysis of Variance - Scores of Boys on Unexposed Material
(N = 22)

Source of variation	d.f.	Mean Square
Between Subjects	21	
Experimental vs. control (EC)	1	14
Error between	20	49.4
Within Subjects		
Pretest vs. control (PP)	1	25
PP x EC.	1	0
Error within	20	13.5

Table 3

Mean Scores on Unexposed Material for Girls (N = 30) and Boys (N = 22)

		Pretest	Posttest	Gain Pre- to Posttest
Boys	Experimental Group	21.8	23.2	+ 1.4
	Control Group	20.5	22.2	+ 1.7
Girls	Experimental Group	19.1	21.6	+ 2.5
	Control Group	22.0	20.9	- 1.1

for control and experimental groups. On pretest, mean scores on the segment of material to be withheld from training were very close - 20.6 and 21.1 for girls and boys respectively. It therefore appears that girls learned a significant amount of material extra-experimentally, but boys did not. Mean scores are shown in Table 3.

Party-affiliation analysis

When party-affiliation scores were analyzed (posttest only) it turned out that this test had very low reliability (0.44). (This "test" was separate from the states-of-origin test even though both were administered simultaneously.) Therefore, this test was incapable of measuring any learning which may have occurred, and it is impossible to establish from the present experiment whether there was any generalization from one dimension of the subject-matter to other dimensions.

As a matter of fact, it was anticipated in advance that this test might have drawbacks, since Ss might be able to guess the party-affiliation by geographical clues (Democrats from southern states, etc.). However, the test was included since it took very little extra time to complete, and no other means of investigating generalization of sets could easily be added. A two-choice question, like party-affiliation, presents special difficulties with Ss of this age group, because many are sophisticated enough to realize that with a Democratic majority present in the Senate a good strategy is to choose the "Democrat" alternative for every senator listed on the test.

Discussion

Girls in the experimental group "learned" statistically significant amounts of unexposed material compared to girls in the control group, although by practical standards the amount is small (see last column Table 3). For

material of this type apparently set-learning effects are small. Nevertheless, the duration of the experiment was less than one month, and the material was difficult. If inducing a set results in the observed amount of learning over a one-month period, it might result in more impressive amounts of learning over longer periods. Furthermore, this kind of learning is a "bonus" -- it is an indirect result of being taught something else.

The sex difference observed here is consonant with other facts that are known to differentiate the sexes. It is puzzling, for instance, why so few women become eminent compared to men. It may be that outstanding achievement requires resistance to prevalent sets, and that gifted men, like the gifted boys in this experiment, fail to develop what might be called a "standard" set.

In another experiment with 6th-grade Ss, it was found that giving a pretest apparently helped bright girls (IQ about 125) on retesting whereas it hindered bright boys (Entwisle, 1961b).[4] In an experiment on the relation between amount of nonsense material recalled and order-of-approximation of the nonsense material to English, King and Cofer (1960) note large differences between sexes, with girls recalling successively larger amounts than boys as words approach English. Their Ss were college students, presumably comparable in IQ level to Ss of the present experiment. Both these experiments, and the present experiment, suggest that sex differences in learning for gifted students bear further investigation.

Pretesting of girls may have established a set to learn material subsequently presented, and not have had this effect for boys. In any case, both the 6th-grade experiment and the present experiment point to the conclusion that experimental procedures, by themselves, have different effects upon Ss of different sex.

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[4] In the present experiment, there were not enough Ss available to study the effects of pretesting itself, even though this would have been desirable. Pretesting by itself may have had differential effects for the two sexes, since the direction of differences from pre- to posttesting is different for the sexes (see Table 3).

To the extent that results of the present experiment can be trusted, it might be advisable to conduct other experiments relating to gifted secondary students with boys only as subjects. The boys appear to be unaffected by the "placebo" components of training in the present experiment, and thus may be more sensitive "discriminators". That is, if benefit from training for some subjects (i.e. girls) is partly owing to training *per se*, and partly to the generalized attention accorded *Ss* during an experiment (a Hawthorne effect), tests of differences between methods of training are less sensitive than tests of differences made using *Ss* who are sensitive to the training procedures alone.

One difficulty afflicting studies like the present one is the shortage of subjects. Even in a large high school, the number of "gifted" students is relatively small, and the difficulty cannot be overcome by using more schools, because of large inter-school variability. Using successive classes in the same school, as was done in this experiment, is useful, yet this tactic has obvious limitations. Also when an experiment lasts over a month and includes 4 separate procedures, the loss of many *Ss* through absence is unavoidable. There does not appear to be any truly satisfactory solution to this problem.

Summary

Although set-learning may be used by gifted girls to some extent, amounts learned by this mechanism in the present experiment are not large. There appeared to be no set-learning effect for boys, although fewer boys could be studied than girls. In this experiment, there was no communication effect between the control and experimental groups like that found previously for elementary-school *Ss*.

On the whole, results of this experiment are negative, but sex differences in learning of gifted students deserve further investigation.

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Appendix A

Pretest

The pretest was given without verbal instructions, and printed instructions on the face sheet said:

"This is a test to see how many U.S. senators you can identify by their home states. For each example, you are to draw a circle around the correct answer. Example:

John Marshall Butler New York Massachusetts Idaho Iowa Maryland

In this case you would draw a circle around "Maryland" to show that John Marshall Butler is a U.S. senator from Maryland.

Please print your name here_____ "

Following this were 96 items of the form

1. George Aiken Kentucky Colorado Texas New Jersey
   Vermont

---

with senators listed in alphabetic order of last name, names of states randomly chosen, and position of the correct answer within the list of states for each question random.

Posttest

The posttest was identical to the pretest except that an "R" or a "D" preceded the question number:

R D 1. George Aiken Kentucky Colorado Texas New Jersey
   Vermont

Ss were instructed by E that the same test would be given as before, but that Ss were to circle the "R" or "D" preceding the question number to indicate whether the senator was Republican or Democrat, respectively.

Appendix B

Raw Scores on Senators' Test

Girls

	Pretest		Posttest	
Experimental Group	Trained* Material	Untrained** Material	Trained* Material	Untrained** Material
1	5	14	13	31
2	8	24	13	22
3	11	23	22	24
4	7	25	21	27
5	4	19	12	18
6	6	15	11	21
7	6	17	17	17
8	3	11	13	15
9	3	15	13	17
10	4	28	21	26
11	5	13	10	14
12	6	20	22	29
13	9	29	18	22
14	7	20	10	21
15	5	14	9	20
Control Group				
1	9	17	5	15
2	8	30	5	22
3	5	27	12	29
4	12	34	8	35
5	4	14	10	18
6	5	17	7	14
7	4	19	8	22
8	7	15	6	18
9	8	20	9	18
10	14	35	13	37
11	6	12	5	13
12	5	25	5	24
13	6	24	4	13
14	7	26	6	22
15	5	15	5	13

* 24 items
** 72 items

Appendix B

Raw Scores on Senators' Test

Boys

Experimental Group	Pretest		Posttest	
	Trained* Material	Untrained** Material	Trained* Material	Untrained** Material
1	3	16	18	25
2	5	18	10	23
3	6	25	18	23
4	3	12	9	12
5	7	25	15	23
6	10	19	10	18
7	5	17	14	19
8	8	23	9	20
9	13	33	21	38
10	7	24	23	32
11	8	28	16	22
Control Group				
1	9	20	4	23
2	10	26	8	24
3	8	26	8	20
4	11	20	7	23
5	9	17	6	21
6	7	23	7	28
7	9	18	11	25
8	9	23	8	18
9	6	15	10	18
10	9	23	9	31
11	6	15	6	13

* 24 items
** 72 items